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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

This Issue

LUBRICATION OF PORTABLE AIR TOOLS

PUBLISHED BY
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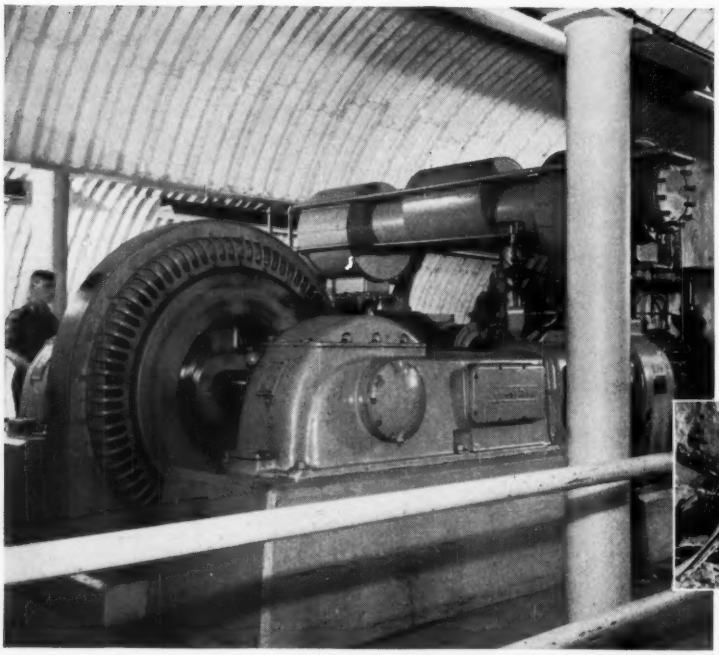
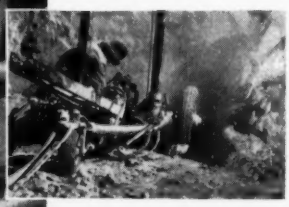
TEXACO PETROLEUM PRODUCTS





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FOR THE MINING INDUSTRY

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

Published by
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Change of Address: In reporting change of address kindly give both old and new addresses.

Lubrication of Portable Air Tools

THE modern high speed air or pneumatic tool is an assembly of precision mechanisms built to very close clearances. Such tools are portable, self-contained in regard to the propelling and operating mechanisms, and function by the energy resulting from the expansion of compressed air. The basic purpose of any air tool is to supplant tedious manual labor with the far more rapid and efficient method of automatic operation. This is accomplished by subjecting the working end of the tool to rotation, repercussion (rapid hammering), constant pressure, or a combination of impact and rotation.

TYPES OF PNEUMATIC TOOLS

There are several types of pneumatic tools depending upon the field of application. In general, air tools fall into two basic categories:

1. *Rotary Vane Tools* – including grinders, sanders, buffers, drills, reamers, tappers, stud setters, wrenches, screw drivers, nut setters.
2. *Percussion Tools* – including chipping hammers, scaling hammers, riveters.

There are, in addition, numerous tools that employ a combination of these two principles. The rock drill is an example.

ROTARY VANE TOOLS

The air driven motor is the heart of the rotary pneumatic tool. The rotor is fitted with suitable vanes and drives the working mechanism, either through direct drive or suitable reduction gearing. Such motors are equipped with control devices including governors, throttle valves, a variety of clutches, etc., depending upon applications involved. This type of air tool has certain outstanding features including:

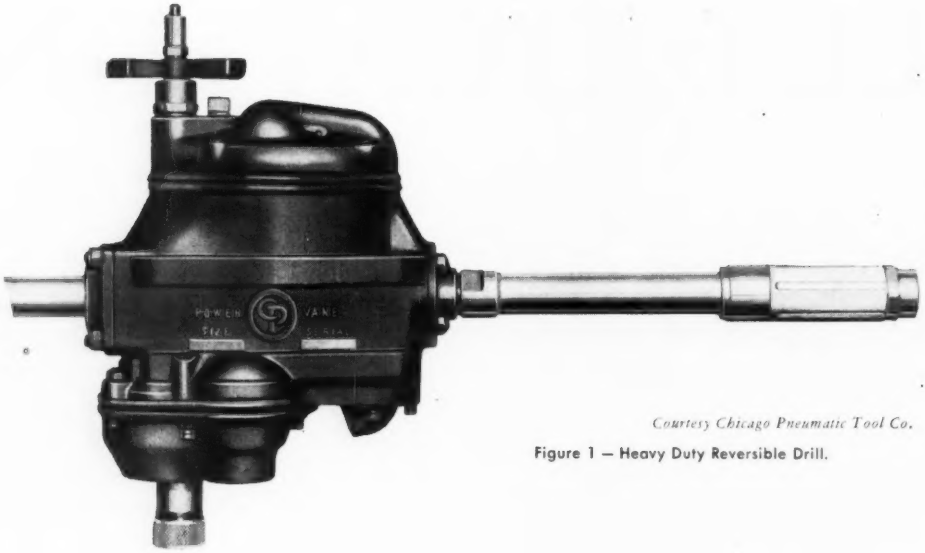
1. Ball bearings.
2. Built-in lubricator (usually).
3. Easily adjusted attachments.
4. Excellent flexibility of control.

Lubrication Requirements

To function at its best, the rotary vane tool must be lubricated properly. The main parts to be lubricated include: (a) vanes and cylinders, (b) reduction gears, and (c) bearings.

The vanes and cylinders require a well refined mineral oil of from 100 to 500 secs. Saybolt Universal Viscosity at 100°F., depending upon temperature, speed and load. Chemical stability, rust protection, and resistance to oxidation and gum formation are important requirements of the oil. In some designs, the oil supply is carried in reservoirs in the tool and delivered to the air stream by means of a lubricator. In other designs, a line oiler may be installed. Sometimes a combination of both is used.

The planetary gears and bearings are grease lubricated by pressure gun through suitable fittings.



Courtesy Chicago Pneumatic Tool Co.

Figure 1 — Heavy Duty Reversible Drill.

The grease should be a product manufactured particularly for this type of service. It should be prepared from selected soaps and mineral oils which are of proven stability, so that the final grease will have adequate resistance to oxidation. In the better greases, oxidation inhibitors are included as well as rust inhibitors for applications where water may be present.

Considerable churning occurs when the gears are operating, meaning that fresh surfaces of grease are being exposed continually to the oxidizing effects of air. These effects normally will be accelerated by the increase in temperature which develops due to internal friction in the lubricant itself. Obviously, deposits accumulating around gears or bearings will prevent free rolling and therefore should be avoided by the use of a suitable grease.

Courtesy Chicago Pneumatic Tool Co.

Figure 2 — Aero Riveting Hammer.

PERCUSSION TOOLS

Where percussive action is employed, air pressure acts on the tool mechanism in much the same manner as steam acts on the pistons of steam engines. In other words, the tool mechanism involves a cylinder with suitable companion piston and valve arrangement for the admission of air at the proper time, according to the number of strokes per minute or percussive frequency required.

Normally two sets of valves are involved; i.e., the throttle valve by which the operator controls the amount of air admitted, and the working valve, which, through suitable timing, controls the frequency with which the air pressure is allowed to react on the piston. As the piston moves back and forth within the cylinder, it strikes rapidly upon the head of the working tool.

Lubrication Requirements

Those parts which require lubrication include the cylinder, the reciprocating piston, the working valve mechanism and the throttle valve. The main moving parts are the piston and working valve.

The lubricant for this type of tool must be such as to lubricate adequately with the least amount of internal friction and tendency to oxidize to form undesirable deposits. In consequence, lubricants for this purpose must be selected with the utmost care. This calls for an oil of the lightest viscosity compatible with temperature and load. Oils are available either compounded or containing special

additives which will emulsify in contact with moisture, and resist oxidation, so that protection of tool parts will be assured and valve sticking will be prevented. Resistance to foaming is another necessary characteristic and extreme pressure properties are also required in many applications.

As air, the motivating power, is constantly being exhausted from the tool, the lubricant is being continually carried out with the exhaust. Thus the lubricant supply must be renewed regularly; otherwise there will be impaired lubrication. Only a limited quantity of oil is carried in the air line oiler or in the internal reservoirs of the average tool; hence frequent refilling is necessary. Larger reservoirs would require more metal, resulting in heavier tools. A pint to a quart of oil per eight hour shift is average consumption. Use of too much oil may result in ignition, comparable to diesel combustion, which would contribute to deposits in the tool. Fortunately, the design and construction of tool housings make it virtually impossible for dirt and grit to enter the mechanism and contaminate the lubricant. Therefore, parts should function indefinitely if properly lubricated and handled in service.

Use of a suitable air line oiler, located in the air hose a few feet back of the drill, is recommended by most manufacturers. These oilers introduce atomized oil into the air stream ahead of the drill. The oil-saturated air then reaches and lubricates all working parts. Oil reservoirs in these line oilers or atomizers are usually large enough to hold sufficient lubricant for one shift of drilling. They assure a constant, steady flow of oil, and should supplant intermittent lubrication by oil reservoirs in the drill. Some operators use these atomizers in conjunction with the regular oil reservoirs in the drill; others depend on them exclusively to supply the required amount of lubricant.

Manufacturers recommend that the line oiler

Courtesy Thor Power Tool Company

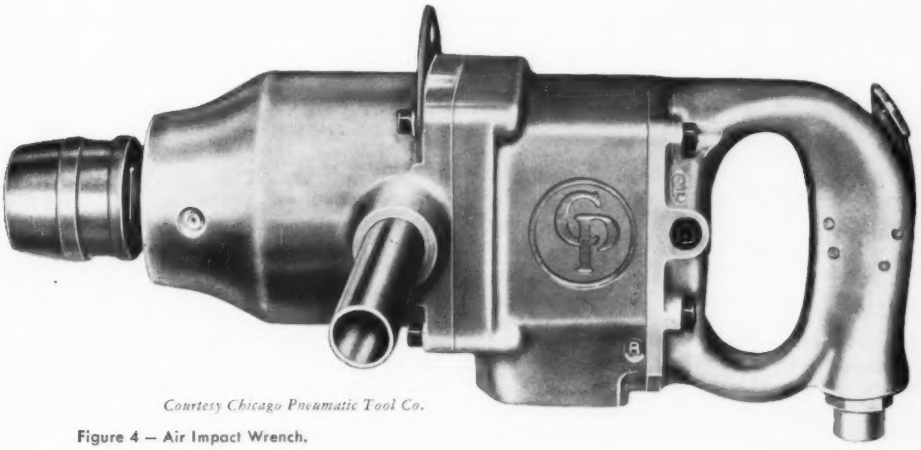
Figure 3 — Rotary Air Grinder.

should never be more than 10 to 12 feet in back of the drill. This allows maximum atomization and minimum oil precipitation before the oil reaches the drill and makes for economy in the use of air hose. It is usual practice to use oil-resistant hose between the line oiler and the rock drill. This is more expensive than regular hose but has proven more economical.

ROCK DRILLS

Operation of the rock drill and many other percussion tools involves both reciprocating and rotating motions. Each presents a different problem of frictional wear.

Moving parts wear similarly to those in a reciprocating engine. The problem of lubricating to prevent metallic wear between cylinder walls and pistons, however, is totally different. In the engine, temperatures are relatively high. During the expansion of air in a percussion tool, low temperatures

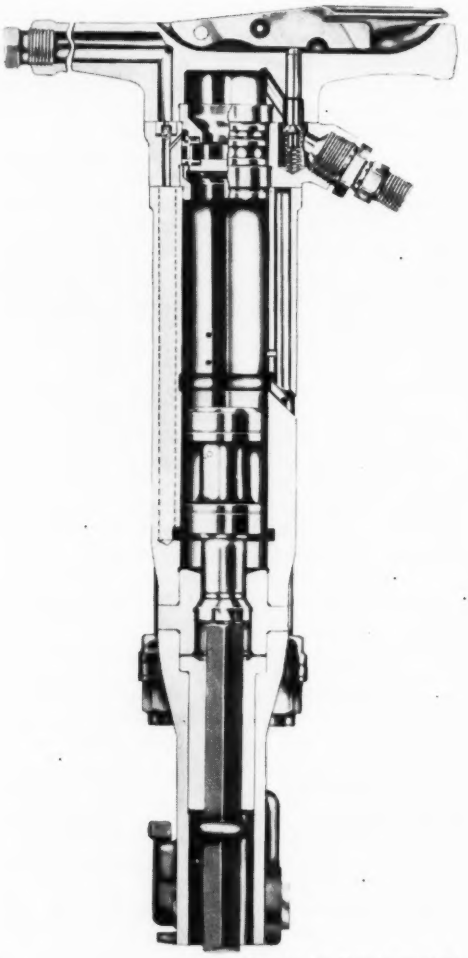


Courtesy Chicago Pneumatic Tool Co.

Figure 4 — Air Impact Wrench.

Courtesy Worthington Corporation

Figure 5 — Pavement Breaker.



Courtesy Joy Manufacturing Co.

Figure 6 — Pavement Breaker.

are developed. Consequently, in air drill service, low temperature operations must be taken into account. Conversely, high temperatures may be met for a number of reasons but primarily because air is often hot when it is delivered to the tool. High atmospheric temperatures accentuate this condition. Accordingly, a range of operating temperatures from 0°F. to 300°F. should be considered.

Types of Drills

Rock drills for quarrying and mining vary in type according to the work to be done. The hammer type of drill, as used for bench work or secondary drilling, is applicable to down-hole work. It may be light enough for hand operation, or so heavy as to require mounting on a tripod or column for mining operations, or on a wagon for open work.

Drills designed for horizontal drilling are essential in mining and tunnel driving. They are generally known as "drifters." A drill for upward drilling is called a "stoper." The drifter drill is usually mounted on a column, "Jumbo" or tripod. When mounted on a portable rig, it is known as a "wagon drill." A "Jumbo" is a portable unit mounted on wheels which can be run on rails. Several drills can be assembled on one unit. The device is used on tunnel construction and underground drifting where two or more drills can be run together advantageously.

Drilling Wet or Dry

Drilling may be either wet or dry, depending on the work being done. In tunnel operations, for example, where "stopers" and other drills are used, it is extremely important to reduce the amount of dust so as to improve working conditions and reduce the personal hazard among the drill runners. This is done by wet drilling. That is, water is injected under pressure through the drill and into the hole being drilled. In addition, a small amount of exhaust air will pass out through the hollow drill. This exhaust air, along with the water, aids in removing drill cuttings from the hole.

A drill for wet drilling is constructed with a tube, extending from the back head through the piston, and thence into the hollow drill. Water passes through this tube under pressure. Any leakage in the water system between the back and the hollow drill floods the working parts with water.

Drills of the hammer type, designed for down-hole quarry or excavation work, very often use air alone, instead of water, for removal of cuttings. They usually operate on the surface and the problem of clean, fresh air, ventilation and dust removal is not so important as in underground work.

Lubrication of drill parts that are commonly exposed to water is very important. These parts include the cylinder, the reciprocating piston, the valve mechanism, and the front head which houses the chuck and rotative element. The rotative impulse may come either from the piston, or from an independent air motor located in the front head, depending on drill design. Where the piston gives the rotation, the chuck rotation nut is splined to the piston, with the piston in turn working on a rifle bar with a pawl ratchet attachment. When an independent motor is used, the motor is connected directly to the chuck parts, and the piston is a free floating member.

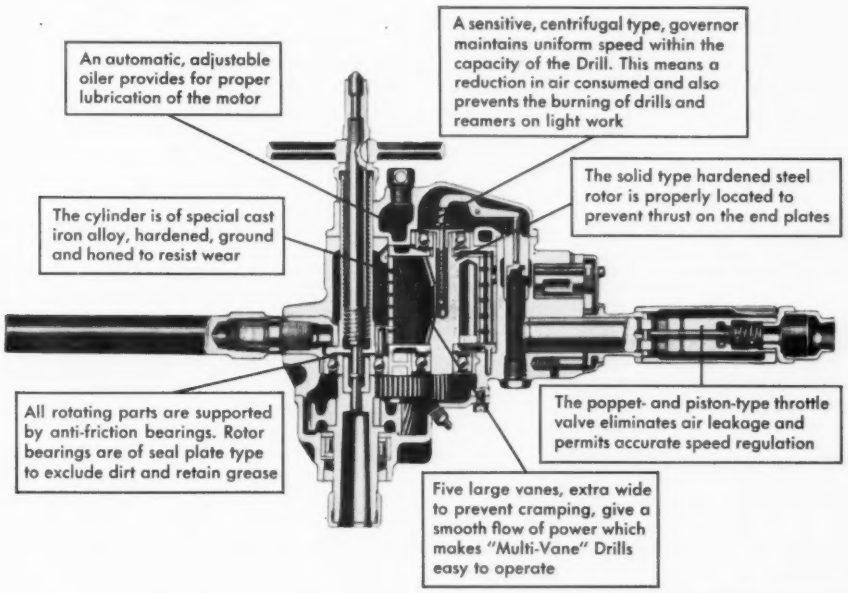
GENERAL LUBRICATION AND CARE OF AIR TOOLS

Many such tools are used under more or less severe operating conditions which include water, dust, dirt and heat.

Water, for example, will tend to wash off the lubricating film from the wearing surfaces. During storage it can cause rust. For this reason, oils which will wet the metal parts and prevent contact with water are recommended. Such lubricants create an adhesive protective film which adequately resists the washing effects of water and sticks tenaciously to all wearing elements.

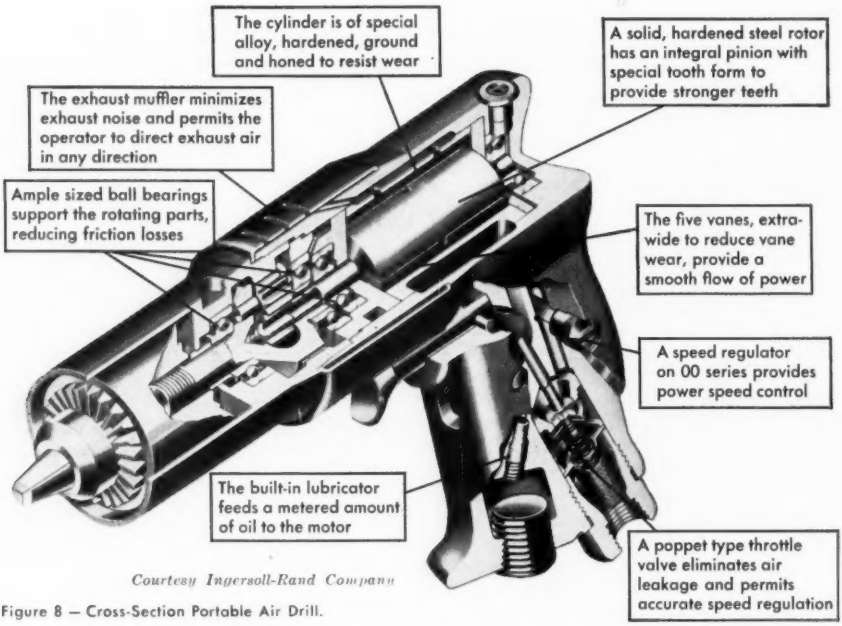
Means of Lubrication

The means by which lubricants are applied or distributed has a marked effect upon the operation of air tools. Even the best of oils or greases may



Courtesy Ingersoll-Rand Company

Figure 7 — Cross-Section Air Drill.



Courtesy Ingersoll-Rand Company

Figure 8 — Cross-Section Portable Air Drill.

fail to do their work if they are used carelessly, or in such a manner that they fail to reach all the wearing elements of the tools. More failures or complaints arise from insufficient lubrication than from any average operating condition. In some cases, this may be due to ignorance; in others, to neglect; often because operators do not fully appreciate the necessity for lubricating their equipment.

Abrasive Wear

Careless handling in the presence of dust and dirt which may enter the tool along with the air is always a potential cause of wear. Normally, it is easy to prevent abrasive foreign matter from entering the tool itself via the air line if an air filter or dirt trap is installed and if the hose is in good condition. Care in handling when not in actual operation will prevent dirt entering from other sources. If the tool is stored in an oil bath or rested in a position or location free from dirt, it should function satisfactorily for an indefinite period.

Clean air should always be used. This will depend, however, upon the location of the compressor, its air intake, whether or not air filters are installed, and the cleanliness of the inter-coolers, pipe lines and air hose. Furthermore, if any of the parts are rusted on the interior surfaces, particles of rust may flake off and be carried along by the air.

To keep out particles of rubber from the air hose and gaskets, which would interfere with the free operation of the tool mechanisms, locating a strainer in the inlet pipe is recommended. Some builders include a strainer or filter in the tool itself. Such strainers should effectively remove the greater part of any solid foreign matter and protect the working mechanisms of the tool. The strainer must be cleaned at frequent and regular intervals.

Automatic lubrication by means of air line oilers or atomizers mechanically delivers the requisite amount of clean oil to the air lines. Lubricators of this type prevent contamination of the oil from exterior sources. Naturally, fresh oil charged to lubricators should be clean, and this can be assured if containers used on the job are of the closed-cover type.

In the absence of automatic means of lubrication, tools must be oiled periodically by hand. There will be more possibility of accidental entry of dust or dirt occurring under such conditions. In some localities the atmosphere will often be laden with dust, and the lubricants should be stored and handled with even greater care. They should be kept in closed containers and placed in a handy location to eliminate loss of time when lubricating.

Rust Protection

Oil is required to lubricate those parts of the air tool which are contacted by compressed air. This means that if the air is moist (as most compressed air is), rusting may occur if the oil does not contain materials to prevent it. These materials cause the lubricant to wet the steel surfaces preferentially in the presence of moisture.

It is quite true that highly refined straight mineral

Courtesy Worthington Corporation

Figure 9 — Triplex Backfill Tamper.

oils are capable of providing adequate lubrication and protection of tools wherever dry air is available, but absolute dryness is never attainable. If the air lines are laid out so that drainage of condensed moisture to traps is assured, if these traps are drained regularly, if effectual water filters are used, if an after-cooler is installed at the compressor — then it is justifiable to assume that moisture-free air is being delivered to the tool. Only under these ideal conditions could a straight mineral oil be expected to provide satisfactory service.

Since ideal conditions do not exist at all times, complete protection against rusting can be expected only by use of a lubricant which will provide rust protection. This type of lubricant is also excellent insurance against rusting when air tools are not in use or must be stored for any length of time.

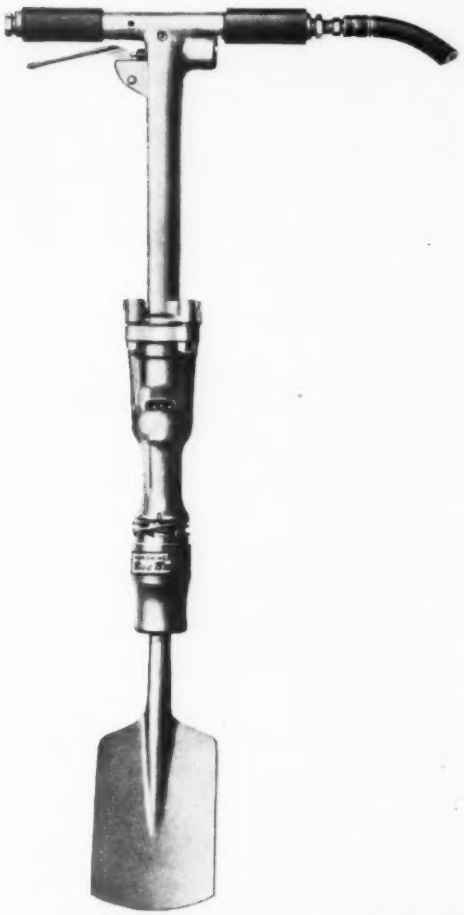
Extreme Pressure and Stability

Fortunately, extreme pressure conditions do not prevail in portable air tools as in rock drills, so extreme pressure characteristics, or EP, are not necessary in small tool lubricants. Extreme pressure properties are essential in a rock drill lubricant to protect rifle bars, nuts and other moving parts from wear under severe load conditions — as when the drill tends to stick in very hard rock or when deep holes are being drilled.

In lubricating small tools it is important to consider the stability of the lubricant — be it an oil or grease. Remember that such tools are precision mechanisms designed with close tolerances and intended to operate at high speeds. Lubricants with suitable oxidation stability prevent the accumulations of deposits on moving parts.

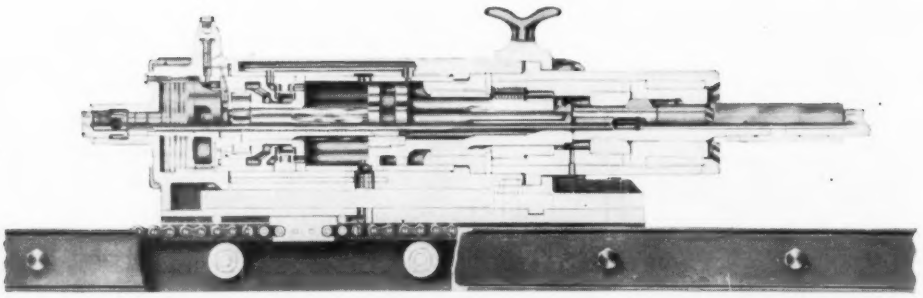
LUBRICATION SERVICE

Air tool engineers suggest placing a piece of *white* paper across the exhaust to tell when to re-oil.



Courtesy Worthington Corporation

Figure 10 — Trench Digger.



Courtesy Joy Manufacturing Co.

Figure 11 — Heavy Duty Percussion Drill.

As long as oil droplets appear on the paper, oil is passing through the tool.

Study of operating conditions, the length of time the tool is used and the capacity of the oiler should furnish data from which the frequency of re-lubrication can be determined. The resultant schedule should be followed carefully. Lack of lubrication can very soon cause the vanes of a rotary tool to warp, burn, chip and crack. While it is true that new vanes are inexpensive and can be readily renewed, nevertheless in the meantime the tool is out of service. In the percussive type tool, scoring of the contact surfaces will result.

CONDITIONING THE AIR

Transmission of air from the compressor to the air tool involves a number of steps, compressor to pipe line to air hose to tool. The air hose is most important. If it is not properly cared for, it can develop leaks, become frayed and accumulate condensed moisture. Then production suffers.

Care of the air transmission system can be summarized as follows:

1. Blow out line before attaching tool. This will help remove water, rust and foreign particles.
2. Use short, large diameter air lines to avoid excessive pressure loss.
3. Restricted connections reduce flow of air. Remove if possible.
4. Don't connect an auxiliary air line to the bottom of a tee. Water may be trapped therein.
5. Check valve from line to tool should be wide open and free from any deposit or restriction.
6. Inspect air lines regularly so they can be kept in good condition.
7. Use high quality hose, built with a lining which will resist the deteriorating effect of oil and heat.
8. Cool the air before using. An after-cooler installed at the compressor is an excellent investment. It is effective in removing heat, oil and water from the air before usage.

TOOL MAINTENANCE

Even with the best of care and lubrication, air tools should be dismantled and cleaned periodically. Preventive maintenance pays off in better tool performance and longer tool life.

Cleaning can be accomplished best by using a solvent such as kerosine or Stoddard Solvent. Normally, these will cut any gummy residues and enable them to be washed out. Where greases are used, more care must be exercised in cleaning out all traces of used lubricant and the bearings properly dried before re-lubricating.

Small percussive type tools can be effectively freed of non-lubricating accumulations and old lubricants by submergence in a bath of a suitable cleaning fluid for a few hours, then blowing out thoroughly with clean air. Large tools, however, may require complete disassembling when cleaning is necessary. If the tool has been laid up for any length of time, the parts should be soaked in solvent to soften or cut any gummy matter and permit easy washing off of such other foreign material which may not be entirely soluble. After re-assembly and prior to reuse, the tools should be blown out and thoroughly lubricated.

When tools are not in use, store in a bath of light rust preventive oil.

SUMMARY

Portable air tools are undoubtedly exposed to greater extremes of operating and maintenance conditions than any other kind of industrial equipment. Even so, their performance for the most part is satisfactory and at times remarkable. This speaks well for the designers and manufacturers. It also reflects favorably on the quality of lubricants available for such applications.

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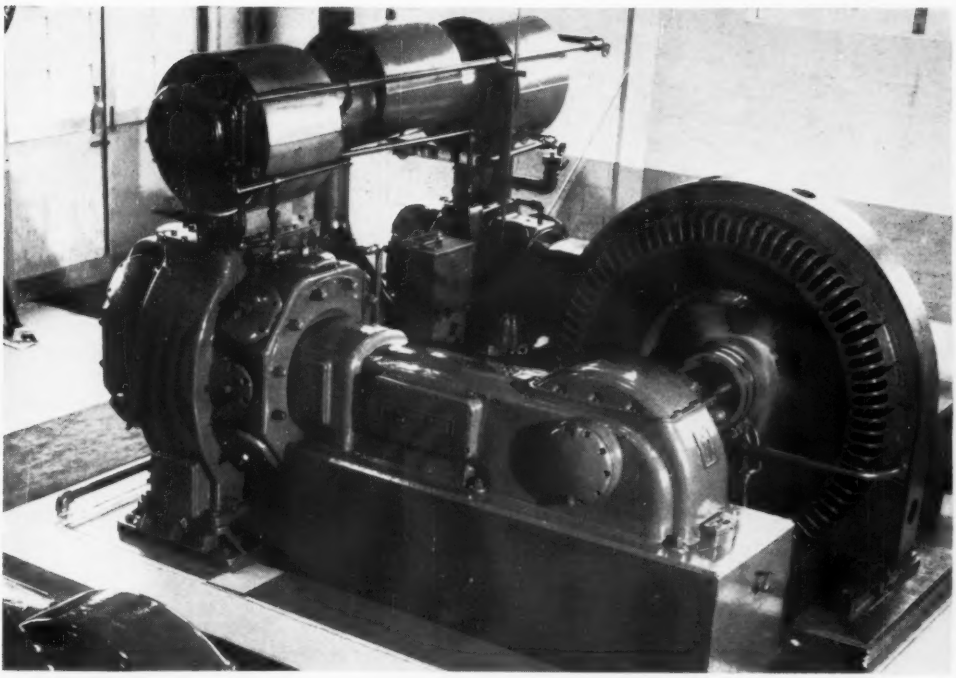

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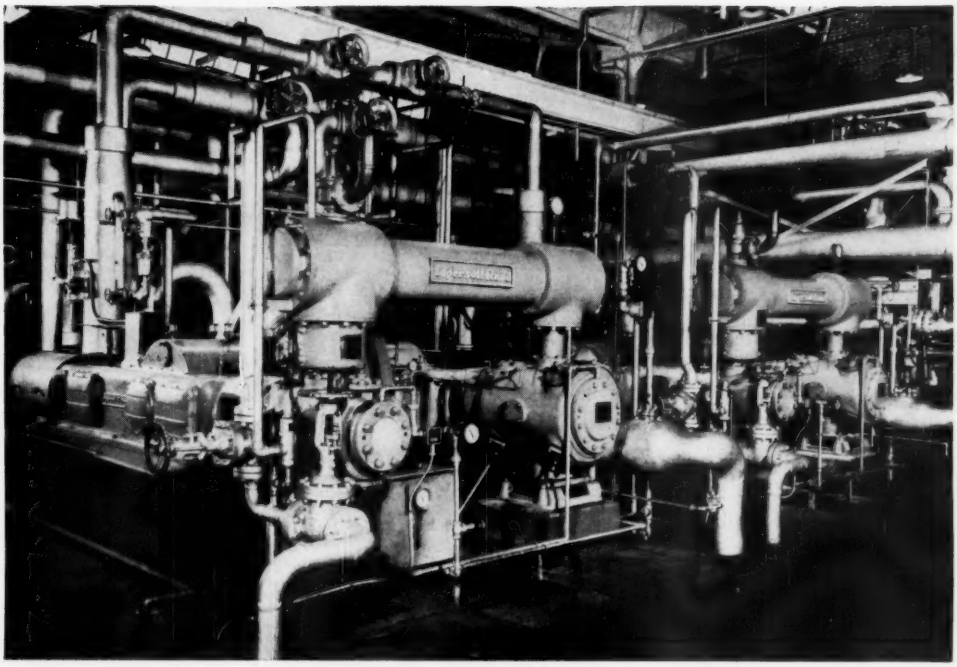

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